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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEY'S DOCKET NUMBER SON-1684/KOI
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INTERNATIONAL APPLICATION NO. PCT/JP99/06713	INTERNATIONAL FILING DATE 30-November 1999	PRIORITY DATE CLAIMED 30 November 1998

TITLE OF INVENTION
ROBOT DEVICE, CONTROL METHOD FOR ROBOT DEVICE, AND PROGRAM RECORDING MEDIUM

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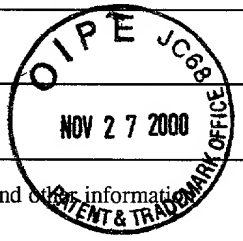

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.

2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.

3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(I).

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2)
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).

6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☒ Amendment to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendment has NOT expired.
   d. ☒ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern either document(s) or information included:

11. ☒ In Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☐ A FIRST preliminary amendment.

    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ A change of power of attorney and/or address letter.

16. ☐ Other items or information.

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U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/701254	PCT/JP99/06713	SON-1684/KOI

17. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CRF 1.49(a)(1)-(5): Search Report has been prepared by the EPO or JPO.....	**$ 870.00**	
International preliminary examination fee paid to USPTO (37 CRF 1.482)		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2).....		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....		
ENTER APPROPRIATE BASIC FEE AMOUNT =	**$ 870.00**	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.49(e)).	$	

Claims	Number Filled	Number Extra	Rate		
Total Claims	92-20=	72	X $18	**$1296**	
Independent Claims	12-3=	9	X $80	**$ 720**	
Multiple dependent claim(s) (if applicable)			+ $270	**$**	
TOTAL OF ABOVE CALCULATIONS			=	**$ 2886.00**	
Reduction by ½ for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28)				**$**	
SUBTOTAL			=	**$ 2886.00**	
Processing fee of $130.00 for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.49(f)).			+	**$**	
TOTAL NATIONAL FEE			=	**$2886.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate sheet (37 CFR 3.28, 3.31). $40.00 per property			+	**$**	
TOTAL FEES ENCLOSED			=	**$ 2886.00**	
				Amount to be refunded:	$
				charged.	**$ 2886.00**

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☒ Please charge my Deposit Account No. 18-0013 in the amount of $ 2886.00 to cover the above fees. A duplicate of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **18-0013** . A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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24,104
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DESCRIPTION

Robot Device, Control Method for Robot Device, and Program Recording Medium

Technical Field

This invention relates to a robot device which acts naturally like a living body, a control method for a robot device, and a program recording medium.

Background Art

Conventionally, there have been developed robot devices in the shape of a multi-limb living animal such as a dog or a cat. Such conventionally proposed robot devices are programmed to simply keep doing predetermined works or can only behave in accordance with a simple sequence.

In some of portable terminals, virtual pets having emotion models are provided. However, such virtual pets cannot live in the actual world and therefore lack reality and a sense of living.

Disclosure of the Invention

In view of the foregoing status of the art, it is an object of the present invention to provide a robot device which can act with reality and a sense of living in the actual world, a control method for a robot device, and a program recording medium.

A robot device according to the present invention includes: an emotion module

in which a plurality of emotion units representing various emotions affect one another to output an emotion; and action means for acting on the basis of the emotion outputted by the emotion module.

This robot device behaves naturally like a living body having reality and a sense of living, on the basis of the output of the emotion module including a plurality of emotion units.

A control method for a robot device according to the present invention includes: an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions affect one another; and an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step.

In this control method for a robot device, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the output at the emotion output step using a plurality of emotion units.

A program recording medium according to the present invention has recorded therein a program for carrying out: an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions affect one another; and an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step.

In this program recording medium, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the

output at the emotion output step using a plurality of emotion units.

Also, a robot device according to the present invention includes: an instinct module in which a plurality of instinct units representing various instincts output individual instincts; and action means for acting on the basis of the instinct outputted by the instinct module.

This robot device behaves naturally like a living body having reality and a sense of living, on the basis of the output of the instinct module including a plurality of instinct units.

A control method for a robot device according to the present invention includes: an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts affect one another; and an action control step of controlling the action of the robot device on the basis of the instinct outputted at the instinct output step.

In this control method for a robot device, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the output at the instinct output step using a plurality of instinct units.

A program recording medium according to the present invention has recorded therein a program for carrying out: an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts affect one another; and an action control step of controlling the action of the robot device on the basis of the instinct outputted at the instinct output step.

In this program recording medium, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the output at the instinct output step using a plurality of instinct units.

Also, a robot device according to the present invention includes: an emotion module in which a plurality of emotion units representing emotions output individual emotions; an instinct module in which a plurality of instinct units representing instincts output individual instincts; and action means for acting on the basis of the emotion outputted by the emotion module and the instinct outputted by the instinct module.

This robot device behaves naturally like a living body having reality and a sense of living, on the basis of the output of the emotion module including a plurality of emotion units and the output of the instinct module including a plurality of instinct units.

A control method for a robot device according to the present invention includes: an emotion output step of outputting individual emotions by a plurality of emotion units representing emotions; an instinct output step of outputting individual instincts by a plurality of instinct units representing instincts; and an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step and the instinct outputted at the instinct output step.

In this control method for a robot device, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the output at the emotion output step using a plurality of emotion units and the

output at the instinct output step using a plurality of instinct units.

A program recording medium according to the present invention has recorded therein a program for carrying out: an emotion output step of outputting individual emotions by a plurality of emotion units representing emotions; an instinct output step of outputting individual instincts by a plurality of instinct units representing instincts; and an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step and the instinct outputted at the instinct output step.

In this program recording medium, a robot device which behaves naturally like a living body having reality and a sense of living is controlled on the basis of the output at the emotion output step using a plurality of emotion units and the output at the instinct output step using a plurality of instinct units.

Brief Description of the Drawings

Fig.1 is a block diagram showing the structure of a robot device according to the present invention.

Fig.2 shows the configuration of a program for controlling the robot device.

Fig.3 illustrates the relation between an emotion module and other objects.

Fig.4 is a flowchart for explaining the operation in the case where external information is entered to the emotion module.

Fig.5 is a flowchart for explaining the state where the emotion module changes

with the lapse of time.

Fig.6 illustrates the relation between an instinct module and other objects.

Fig.7 is a flowchart for explaining the operation in the case where external information is entered to the instinct module.

Fig.8 is a flowchart for explaining the state where the instinct module changes with the lapse of time.

Fig.9 illustrates the state where the robot device is communicating with another robot device.

Fig.10 illustrates the state where a personal computer controls the emotion and action of the robot device.

Best Mode for Carrying Out the Invention

A preferred embodiment of the present invention will now be described in detail with reference to the drawings.

The present invention is applied to a robot device 1 having the structure as shown in Fig.1.

The robot device 1 includes a central processing unit (hereinafter referred to as CPU) 11 for controlling the entire system, a video camera 12 having a CCD (charge coupled device) image sensor, a storage section 13 for storing video data from the video camera 12, and a large-scale integrated circuit (hereinafter referred to as LSI) 14 which collectively includes a host controller of a serial bus and the like.

The LSI 14 has a communication section 14a constituted by an interface for serial communication, parallel communication or USB communication, and is connected to an external personal computer 100 via the communication section 14a. In this case, the personal computer 100 can change a program for causing the CPU 11 to operate or can manipulate the CPU 11 via the LSI 14.

The LSI 14 has a PC card interface 15 and is thus connected to various devices of the PC card standard, for example, a storage device 200 such as an ATA (advanced technology attachment) flash memory card and a communication device 300 such as a radio communication card.

In the storage device 200, various parameters for controlling the emotion level of emotion units and the instinct level of instinct units are stored. Specifically, an emotion parameter, an input action parameter, an attenuation parameter, an interaction parameter and the like are stored, which are elements for changing and controlling the emotion level of the emotion units. Also, an instinct parameter, an input action parameter, an increase parameter and the like are stored, which are elements for changing and controlling the instinct level of the instinct units. At the time of execution, these parameters are read out and used from the storage device 200.

The LSI 14 has a timer, not shown, for obtaining real-time information, and a battery manager, not shown, for managing the remaining quantity of the battery and for carrying out control in cooperation with the timer so as to turn on the power at a certain time point.

The robot device 1 also has first to fourth CPC (configurable physical component) devices 20, 30, 40 and 40, which constitute limbs, ears and mouth. Each CPC device is connected to a serial bus hub (SBH) 14b in the LSI 14. While the four CPC devices are shown in this embodiment, it is a matter of course that the number of CPC devices is not particularly limited.

The first CPC device 20 has a hub 21 for controlling each circuit within the device in response to a control command from the LSI 14, a memory 22 for temporarily storing a control signal and a detection signal, an acceleration sensor 23 for detecting the acceleration, a potentiometer 24, and an actuator 25 which serves as a junction or the like. The acceleration sensor 23 detects the acceleration in three axial directions by several ten milliseconds and supplies the results of detection to the CPU 11 via the hub 21 and the serial bus hub 14b.

The second CPC device 30 has a hub 31, a memory 32, a rotation angular velocity sensor 33 made up of a gyro sensor for detecting the rotation angular velocity, a potentiometer 34, and an actuator 35. The rotation angular velocity 33 detects the rotation angular velocity in three angular directions by several ten milliseconds and supplies the results of detection to the LSI 14 via the hub 31 and the serial bus hub 14b.

The third CPC device 40 has a hub 41, a memory 42, a light-emitting diode (LED) 43 for emitting a light to indicate the reception of an external stimulus, and a touch sensor 44 for detecting whether the exterior is touched or not.

The fourth CPC device 50 has a hub 51, a memory 52, a speaker 53 which serves as a "mouth" for outputting a sound to the outside, and a microphone 54 which serves as an "ear" for detecting an external sound.

The appearance of the robot device 1 is the shape of a multi-limb walking robot. Specifically, the robot device 1 is a multi-joint robot of a multi-limb walking type and is in the shape of an animal having four limbs. However, the robot device is not limited to this. For example, a multi-joint robot of a two-limb walking type may also be used.

The acceleration sensor 23 detects the acceleration with respect to the directions of X-axis, Y-axis and Z-axis. The rotation angular velocity sensor 33 detects the rotation angular velocity with respect to angle R, angle P and angle Y for rotations about the X-axis, Y-axis and Z-axis as rotation axes.

A program for controlling the robot device 1 is designed in a hierarchical configuration as shown in Fig.2. Specifically, the program is configured by forming three layers of system software, middleware and application on the embedded real-time OS (operating system) which operates on the hardware of the above-described structure.

The system software layer includes a device driver for directly controlling the device, and a server object for providing a service to objects of upper layers.

The middleware layer includes a recognition object for processing sensor information such as image, sound and touch, a motion control object for controlling

the motion of the robot such as walking and posture, and an action production object for moving the limbs, head and tail to express actions.

The application layer includes a learning object for learning, an emotion/instinct model object for handling emotions and instincts, a behavior production object for determining the behavior, and a scenario object for characterizing the entire robot device.

The emotion/instinct model object includes an emotion module and an instinct module.

The emotion module handles a plurality of types of emotion units as data. An emotion unit is constituted by a current level of emotion (hereinafter referred to as emotion level), a minimum emotion level, a maximum emotion level, and a threshold value as a reference for notification of the emotion. The emotion units are prepared corresponding to the types of emotions to be handled, including emotions such as delight, grief, anger, horror, surprise and hatred. The emotion level of each of these emotions is first initialized by the value of an emotion parameter and then varies in accordance with external information from the recognition object or the like and with the lapse of time.

The respective emotion units have such nature as to affect one another by mutually enhancing or lowering the emotion levels. For example, when the emotion unit of grief has a high emotion level, the emotion unit of anger has a high emotion level, too. When the emotion unit of delight has a high emotion level, the emotion

units of anger and hatred have low emotion levels. The above-described emotion units are only typical examples and this invention is not limited to these examples.

The instinct module handles instinct units as data, similarly to the emotion module.

An instinct unit is constituted by a current level of instinct (hereinafter referred to as instinct level), a minimum instinct level, a maximum instinct level, and a threshold value as a reference for notification of the instinct. The instinct units are prepared corresponding to the types of instincts to be handled, including instinctive desires such as appetite, desire to exercise, desire to rest, desire for affection, desire to learn and sexual desire. The instinct level of each of these instincts is first initialized by the value of an instinct parameter and then varies in accordance with external information from the recognition object or the like and with the lapse of time. Unlike the emotion units, the instinct units do not mutual enhance the instinct levels. However, the instinct module and the emotion module may affect each other. For example, when the robot device "feels hungry" in terms of the instinct, it is likely to be "angry" as an expression of the emotion.

The above-described objects are configured by an object-oriented design. Regardless of an upper layer or a lower layer, the state of an object is changed in accordance with the reception of information from another object and the information corresponding to its own state is outputted to another object. That is, the objects mutually communicate information and affect one another. As such objects, various

elements related to behaviors of a living body can be applied, such as elements of behaviors of a living body (e.g., learning, thinking, recognition) and means for performing behaviors of a living body (limbs, joints, motion control).

The behavior based on the output of the emotion module will now be described.

In the emotion module, the emotion level of each emotion unit may be changed by inputting external information or may change by itself with the lapse of time.

First, the above-described recognition object handles input information such as color information of an image from a color sensor, sound information of the speaker from a sound sensor and touch information from a touch sensor, as various sensor information of the to fourth CPC devices 20, 30, 40, 50, which are hardware, shown in Fig.1. On recognizing information to be notified of, the recognition object notifies the emotion module of the emotion/instinct model object, of the information of the result of recognition, as shown in Fig.3.

When the information is inputted from the recognition object, the emotion module discriminates the type of the inputted information (step ST1) and changes the emotion level of each emotion unit using the parameter corresponding to the inputted information (step ST2), as shown in Fig.4. Then, the emotion module selects the emotion unit having the maximum emotion level from among the emotion units having the emotion levels exceeding the threshold value. The selected emotion unit notifies the object which is requesting the output, for example, the behavior production object, of that information. The object which is requesting the output must register itself as

an observer to the emotion module, using an object-oriented observer pattern. The emotion module may accept an input from an object which does not directly handle the sensor information, for example, by accepting a message to the effect that the instinct module has solved frustration.

The behavior production object controls the hardware via the action production object or the like. Specifically, the behavior production object controls the first to fourth CPC devices 20, 30, 40, 50 shown in Fig.1 so as to take actions using the limbs, head and tail, generation of sounds, and flashing of the LED, thereby expressing emotions.

Meanwhile, as the time elapses, the emotion module carries out the processing of step ST11 and the subsequent steps shown in Fig.5.

At step ST11, the emotion module initializes the emotion level and parameter and then proceeds to step ST12.

At step ST12, the emotion module discriminates whether a predetermined time has elapsed or not, using the timer provided in the LSI 14. If the predetermined time has not elapsed, the emotion module waits at step ST12. If the predetermined time has elapsed, the emotion module proceeds to step ST13.

At step ST13, the emotion module attenuates the emotion level of each emotion unit and proceeds to step ST14. The degree of attenuation is determined by an attenuation parameter stored in the storage section 13.

At step ST14, the emotion module changes the emotion level by mutual

restraint/simulation of the respective emotions and proceeds to step ST15. For example, increased horror reduced delight, and increased hatred increases anger. The relation and degree of interaction is determined by a mutual parameter stored in the storage section 13.

At step ST15, the emotion module discriminates whether there is any emotion unit having the emotion level exceeding the threshold value. If there is no such emotion unit, the emotion module returns to step ST12. If there is such an emotion unit, the emotion module proceeds to step ST16.

At step ST16, the emotion module selects the emotion unit having the maximum emotion level from among the emotion units having the emotion levels exceeding the threshold value, and then proceeds to step ST17.

At step ST17, the emotion module notifies the behavior production object of the information of the selected emotion unit. The selected emotion unit notifies the object which is requesting the output, for example, the behavior production object, of that information. The emotion module may accept an input from an object which does not directly handle the sensor information, for example, by accepting a message to the effect that the instinct module has solved frustration.

The behavior production object controls the hardware via the action production object or the like. Specifically, the behavior production object controls the first to fourth CPC devices 20, 30, 40, 50 shown in Fig.1 so as to take actions using the limbs, head and tail, generation of sounds, and flashing of the LED, thereby expressing

emotions. Then, the emotion module returns to step ST12 again.

As the emotion module thus notifies another object of the information of the emotion unit having the maximum emotion level, from among the emotion units having the emotion levels changed by external information or internal changes, the behavior production object can be notified of the state where various emotions get complicated with one another. On the basis of the information from the emotion module, the behavior production object controls the first to fourth CPC devices 20, 30, 40, 50, which are hardware, via the system software and OS.

As described above, in the robot device 1, since the emotion module notifies the behavior production object of the information of the emotion unit having the highest emotion level when various emotions are organically associated with one another in a complicated manner, the optimum emotional expression corresponding to the status can be realized.

In addition to the emotion module which reacts to the input from the external world, the robot device 1 has the instinct module in which desires are gradually increased from inside. Thus, the behavior based on the output of the instinct module will now be described.

In the instinct module, the instinct level of each instinct unit may be changed by inputting external information or may change by itself with the lapse of time.

First, the above-described recognition object handles input information such as color information of an image from a color sensor, sound information of the speaker

from a sound sensor and touch information from a touch sensor, as various sensor information of the to fourth CPC devices 20, 30, 40, 50, which are hardware, shown in Fig.1. On recognizing information to be notified of, the recognition object notifies the instinct module of the emotion/instinct model object, of the information of the result of recognition, as shown in Fig.6.

When the information is inputted from the recognition object, the instinct module discriminates the type of the inputted information (step ST21) and changes the instinct level of each instinct unit using the parameter corresponding to the inputted information (step ST22), as shown in Fig.7. For example, when the remaining battery capacity is reduced, the instinct level of the instinct unit of appetite is increased and the desire to eat/drink, for example, the request for charging is increased. The instinct module may accept information outputted from an object which does not handle the information from the various sensors, for example, information outputted from the behavior production module or the action production module on completion of the desired behavior. For example, when the end of hard exercise is notified of, the instinct level of desire to exercise is significantly attenuated.

The instinct module selects the instinct unit having the maximum instinct level from among the instinct units having the instinct levels exceeding the threshold value. The selected instinct unit notifies the object which is requesting the output, for example, the behavior production object, of that information. The object which is requesting the output must register itself as an observer to the instinct module, using

an object-oriented observer pattern.

The behavior production object controls the hardware via the action production object or the like. Specifically, the behavior production object controls the first to fourth CPC devices 20, 30, 40, 50 shown in Fig.1. For example, the behavior production object causes the limbs, head and tail to move so as to perform hard exercise when the desire to exercise is enhanced and so as to rest when the desire to rest is enhanced, thereby expressing instincts.

Meanwhile, as the time elapses, the instinct module carries out the processing of step ST31 and the subsequent steps shown in Fig.8.

At step ST31, the instinct module initializes the instinct level and parameter and then proceeds to step ST32.

At step ST32, the instinct module discriminates whether a predetermined time has elapsed or not, using the timer provided in the LSI 14. If the predetermined time has not elapsed, the instinct module waits at step ST32. If the predetermined time has elapsed, the instinct module proceeds to step ST33.

At step ST33, the instinct module increases the instinct level of each instinct unit and proceeds to step ST34. The degree of increase is determined by an increase parameter stored in the storage section 13.

At step ST34, the instinct module discriminates whether there is any instinct unit having the instinct level exceeding the threshold value. If there is no such instinct unit, the instinct module returns to step ST32. If there is such an instinct unit, the

instinct module proceeds to step ST35.

At step ST35, the instinct module selects the instinct unit having the maximum instinct level from among the instinct units having the instinct levels exceeding the threshold value, and then proceeds to step ST36.

At step ST36, the instinct module notifies the client module such as the behavior production object of the information of the selected instinct unit. The selected instinct unit notifies the object which is requesting the output, for example, the behavior production object, of that information.

The behavior production object controls the hardware via the action production object or the like, and then returns to step ST32.

As the instinct module thus notifies another object of the information of the instinct unit having the maximum instinct level, from among the instinct units having the instinct levels changed by external information or internal changes, the behavior production object can be notified of the state where an instinct is enhanced. On the basis of the information from the instinct module, the behavior production object controls the first to fourth CPC devices 20, 30, 40, 50, which are hardware, via the system software and OS. Thus, the optimum instinctive expression corresponding to the status can be realized.

As is described above, both the emotion module and the instinct module operate on the basis of the information from the various objects, but they are controlled independently in parallel. Thus, a complicated psychological condition in which

various emotions and instincts coexist can be expressed by the robot device 1 in a natural way.

The robot device 1 also has a learning function. That is, emotion parameters and instinct parameters, which are elements for changing the emotion level of each emotion unit and the instinct level of each instinct unit, are stored in the storage device 200, as described above. In the case where the robot device 1 itself learns and grows, the character and behavior can be changed as the learning object rewrites various parameters in the storage device 200.

Also, the robot device 1 can communicate with another robot device 1A, not shown, via the communication device 300.

Specifically, the emotion module of the robot device 1 notifies the communication device 300 (e.g., a radio communication card) of the information of the emotion unit of the highest emotion level. The communication device 300 transmits the information of this emotion unit through radio communication to the other robot device 1A which is designated in advance. Thus, the other robot device 1A can read the emotion of the robot device 1, and communication with emotions can be realized between the robot device 1 and the other robot device 1A.

For example, if the robot device 1 is angry, the other robot device 1A can behave accordingly. Specifically, when the robot device 1 determines that the other robot device 1A is breaking into the territory of the robot device 1, the robot device 1 behaves on the basis of anger and takes an action such as barking as shown in Fig.9.

In response to this, the emotion level of the emotion unit of anger of the robot device 1 is increased. In this case, the emotion level of the emotion unit of anger is transmitted from the communication device 300 of the robot device 1 to the other robot device 1A.

The other robot device 1A, having received the emotion of anger of the robot device 1, takes an action of running away in response thereto, as shown in Fig.9. The action of running away of the other robot device 1A is taken as the emotion level of the emotion of horror or surprise of the other robot device 1A is increased in response to the emotion of anger transmitted from the robot device 1.

In this manner, the communication with emotions between the robot device 1 and the other robot device 1A and the corresponding behaviors can be taken. However, such behaviors are not limited to the above-described behaviors.

For example, if the robot device 1 is delighted, the other robot device 1A can behave delightedly in response thereto. Specifically, the other robot device 1A, having received the emotion of delight of the robot device 1, has its own emotion level of delight enhanced in response to the emotion of delight transmitted from the robot device 1 and behaves delightedly together with the robot device 1.

The information of the instinct units can be similarly transmitted from the robot device 1 to the other robot device 1A. Thus, the communication between the robot devices can be realized with respect to the information of the instinct units.

Moreover, not only the communication between the robot devices but also the

communication between the robot device and a personal computer (PC) 400 may be carried out, as shown in Fig.10. That is, the PC can control the output of the emotion module of the robot device 1 so as to make the robot device 1 behave in response to the emotion.

Wired communication may also be carried out as well as radio communication. As a matter of course, the information of the emotion units in the robot device 1 may be recorded on a recording medium such as a memory card, which can be loaded into the other robot device 1A.

The robot device 1 can communicate with an electronic pet in a virtual pet device described in the Japanese Patent Application No.H10-030793, as long as it has the same interface.

In addition, in order to operate the robot device 1 of the above-described hardware structure, a recording medium such as a memory card may be loaded into the robot device 1 so as to install therein a control program recorded on the recording medium. The control program recorded on the recording medium may be a control program configured by OS, system software, middleware and application as shown in Fig.2.

Industrial Applicability

With the robot device, the control method for a robot device and the program recording medium according to the present invention, an emotion is outputted as a

plurality of emotion units representing various emotions of the object-oriented design affect one another, and the robot device acts on the basis of the outputted emotion. Thus, it can behave naturally like a living body having reality and a sense of living.

Claims

1. A robot device comprising:

an emotion module in which a plurality of emotion units representing various emotions affect one another to output an emotion; and

action means for acting on the basis of the emotion outputted by the emotion module.

2. The robot device as claimed in claim 1, further comprising a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body,

wherein the emotion module outputs an emotion as the plurality of emotion units affect one another on the basis of information from the plurality of objects, and

the plurality of objects affect one another and affect the emotion from the emotion module so as to output the information.

3. The robot device as claimed in claim 1, wherein the emotion units are designed by an object-oriented design.

4. The robot device as claimed in claim 2, wherein the action means includes a plurality of objects each being designed by an object-oriented design corresponding to means for the behavior of the living body.

5. The robot device as claimed in claim 1, wherein the emotion module outputs information of an emotion unit having the highest emotion level as the emotion, of the

plurality of emotion units having affected one another.

6. The robot device as claimed in claim 5, wherein the respective emotion units of the emotion module affect one another on the basis of external information.

7. The robot device as claimed in claim 5, wherein the respective emotion units of the emotion module affect one another with the lapse of time.

8. The robot device as claimed in claim 1, further comprising storage means for storing a plurality of parameters for controlling the state of emotion of each emotion unit,

wherein the emotion module controls the state of emotion of each emotion unit on the basis of each parameter stored in the storage means.

9. The robot device as claimed in claim 1, further comprising transmission/reception means for transmitting an emotion outputted by the emotion module and/or receiving an emotion from outside and for notifying the action means of the emotion.

10. The robot device as claimed in claim 9, wherein the robot device behaves in accordance with the emotion of another robot device received by the transmission/reception means.

11. The robot device as claimed in claim 10, wherein the emotion module changes the state of emotion of the emotion unit in accordance with the emotion of another robot device.

12. The robot device as claimed in claim 2, further comprising an instinct module

for outputting an instinct as a plurality of instinct units representing various instincts change their respective instinct levels,

wherein the emotion module and the instinct module operate independently while affecting the plurality of objects, and

the action means acts on the basis of the output from the emotion module and the instinct module.

13. A control method for a robot device comprising:

an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions affect one another; and

an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step.

14. The control method for a robot device as claimed in claim 13, wherein at the emotion output step, the plurality of emotion units affect one another to output an emotion on the basis of information from a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body, and

the plurality of objects affect one another and affect the emotion from the emotion output step so as to output the information.

15. The control method for a robot device as claimed in claim 13, wherein the emotion units are designed by an object-oriented design.

16. The control method for a robot device as claimed in claim 13, wherein at the emotion output step, information of an emotion unit having the highest emotion level

is outputted as the emotion, of the plurality of emotion units having affected one another.

17. The control method for a robot device as claimed in claim 16, wherein at the emotion output step, the respective emotion units of the emotion module affect one another on the basis of external information.

18. The control method for a robot device as claimed in claim 16, wherein at the emotion output step, the respective emotion units of the emotion module affect one another with the lapse of time.

19. The control method for a robot device as claimed in claim 13, wherein at the emotion output step, the state of emotion of each emotion unit is controlled on the basis of a parameter for controlling the state of emotion of each emotion unit.

20. The control method for a robot device as claimed in claim 13, wherein the emotion of another robot device outputted by said another robot device is received and a behavior corresponding to the emotion of said another robot device is taken.

21. The control method for a robot device as claimed in claim 20, wherein at the emotion output step, the state of emotion of the emotion unit is changed in response to the emotion of said another robot device.

22. The control method for a robot device as claimed in claim 14, further comprising an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts change their respective instinct levels,

wherein at the emotion output step and the instinct output step, the emotion and

the instinct are affected by the plurality of objects and are independently outputted, and

at the action control step, the action of the robot device is controlled on the basis of the emotion and the instinct outputted at the emotion output step and the instinct output step.

23. A program recording medium having recorded therein a program for carrying out:

an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions affect one another; and

an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step.

24. The program recording medium as claimed in claim 23, wherein at the emotion output step, the plurality of emotion units affect one another to output an emotion on the basis of information from a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body, and

the plurality of objects affect one another and affect the emotion from the emotion output step so as to output the information.

25. The program recording medium as claimed in claim 23, wherein the emotion units are designed by an object-oriented design.

26. The program recording medium as claimed in claim 23, wherein at the emotion output step, information of an emotion unit having the highest emotion level is

outputted as the emotion, of the plurality of emotion units having affected one another.

27. The program recording medium as claimed in claim 26, wherein at the emotion output step, the respective emotion units of the emotion module affect one another on the basis of external information.

28. The program recording medium as claimed in claim 26, wherein at the emotion output step, the respective emotion units of the emotion module affect one another with the lapse of time.

29. The program recording medium as claimed in claim 23, wherein at the emotion output step, the state of emotion of each emotion unit is controlled on the basis of a parameter for controlling the state of emotion of each emotion unit.

30. The program recording medium as claimed in claim 23, wherein the emotion of another robot device outputted by said another robot device is received and a behavior corresponding to the emotion of said another robot device is taken.

31. The program recording medium as claimed in claim 30, wherein at the emotion output step, the state of emotion of the emotion unit is changed in response to the emotion of said another robot device.

32. The program recording medium as claimed in claim 24, further comprising an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts change their respective instinct levels,

wherein at the emotion output step and the instinct output step, the emotion and the instinct are affected by the plurality of objects and are independently outputted,

and

at the action control step, the action of the robot device is controlled on the basis of the emotion and the instinct outputted at the emotion output step and the instinct output step.

33. A robot device comprising:

an instinct module in which a plurality of instinct units representing various instincts output individual instincts; and

action means for acting on the basis of the instinct outputted by the instinct module.

34. The robot device as claimed in claim 33, further comprising a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body,

wherein the plurality of instinct units of the instinct module output an instinct on the basis of information from the plurality of objects, and

the plurality of objects affect one another and affect the instinct from the instinct module so as to output the information.

35. The robot device as claimed in claim 33, wherein the instinct units are designed by an object-oriented design.

36. The robot device as claimed in claim 34, wherein the action means includes a plurality of objects each being designed by an object-oriented design corresponding to means for the behavior of the living body.

37. The robot device as claimed in claim 33, wherein the instinct module outputs information of an instinct unit having the highest instinct level as the instinct.

38. The robot device as claimed in claim 37, wherein the instinct module outputs the instinct on the basis of external information.

39. The robot device as claimed in claim 37, wherein the respective instinct units of the instinct module output the instinct with the lapse of time.

40. The robot device as claimed in claim 33, further comprising storage means for storing a plurality of parameters for controlling the state of instinct of each instinct unit,

wherein the instinct module controls the state of instinct of each instinct unit on the basis of each parameter stored in the storage means.

41. The robot device as claimed in claim 33, further comprising transmission/reception means for transmitting an instinct outputted by the instinct module and/or receiving an instinct from outside and for notifying the action means of the instinct.

42. The robot device as claimed in claim 41, wherein the robot device behaves in accordance with the instinct of another robot device received by the transmission/reception means.

43. The robot device as claimed in claim 42, wherein the instinct module changes the state of instinct of the instinct unit in accordance with the instinct of another robot device.

44. The robot device as claimed in claim 34, further comprising an emotion module for outputting an emotion as a plurality of emotion units representing various emotions change their respective emotion levels,

wherein the instinct module and the emotion module operate independently while affecting the plurality of objects, and

the action means acts on the basis of the output from the instinct module and the emotion module.

45. A control method for a robot device comprising:

an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts affect one another; and

an action control step of controlling the action of the robot device on the basis of the instinct outputted at the instinct output step.

46. The control method for a robot device as claimed in claim 45, wherein at the instinct output step, the plurality of instinct units output an instinct on the basis of information from a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body, and

the plurality of objects affect one another and affect the instinct from the instinct output step so as to output the information.

47. The control method for a robot device as claimed in claim 45, wherein the instinct units are designed by an object-oriented design.

48. The control method for a robot device as claimed in claim 45, wherein at the

instinct output step, information of an instinct unit having the highest instinct level is outputted as the instinct.

49. The control method for a robot device as claimed in claim 48, wherein at the instinct output step, an instinct is outputted on the basis of external information.

50. The control method for a robot device as claimed in claim 48, wherein at the instinct output step, the respective instinct units output an instinct with the lapse of time.

51. The control method for a robot device as claimed in claim 45, wherein at the instinct output step, the state of instinct of each instinct unit is controlled on the basis of a parameter for controlling the state of instinct of each instinct unit.

52. The control method for a robot device as claimed in claim 45, wherein the instinct of another robot device outputted by said another robot device is received and a behavior corresponding to the instinct of said another robot device is taken.

53. The control method for a robot device as claimed in claim 52, wherein at the instinct output step, the state of instinct of the instinct unit is changed in response to the instinct of said another robot device.

54. The control method for a robot device as claimed in claim 46, further comprising an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions change their respective emotion levels,

wherein at the instinct output step and the emotion output step, the instinct and the emotion are affected by the plurality of objects and are independently outputted,

and

at the action control step, the action of the robot device is controlled on the basis of the instinct and the emotion outputted at the instinct output step and the emotion output step.

55. A program recording medium having recorded therein a program for carrying out:

an instinct output step of outputting an instinct as a plurality of instinct units representing various instincts affect one another; and

an action control step of controlling the action of the robot device on the basis of the instinct outputted at the instinct output step.

56. The program recording medium as claimed in claim 55, wherein at the instinct output step, the plurality of instinct units output an instinct on the basis of information from a plurality of objects each being designed by an object-oriented design corresponding to the behavior of a living body, and

the plurality of objects affect one another and affect the instinct from the instinct output step so as to output the information.

57. The program recording medium as claimed in claim 55, wherein the instinct units are designed by an object-oriented design.

58. The program recording medium as claimed in claim 55, wherein at the instinct output step, information of an instinct unit having the highest instinct level is outputted as the instinct.

59. The program recording medium as claimed in claim 58, wherein at the instinct output step, an instinct is outputted on the basis of external information.

60. The program recording medium as claimed in claim 58, wherein at the instinct output step, the respective instinct units output an instinct with the lapse of time.

61. The program recording medium as claimed in claim 55, wherein at the instinct output step, the state of instinct of each instinct unit is controlled on the basis of a parameter for controlling the state of instinct of each instinct unit.

62. The program recording medium as claimed in claim 55, wherein the instinct of another robot device outputted by said another robot device is received and a behavior corresponding to the instinct of said another robot device is taken.

63. The program recording medium as claimed in claim 62, wherein at the instinct output step, the state of instinct of the instinct unit is changed in response to the instinct of said another robot device.

64. The program recording medium as claimed in claim 56, further comprising an emotion output step of outputting an emotion as a plurality of emotion units representing various emotions change their respective emotion levels,

wherein at the instinct output step and the emotion output step, the instinct and the emotion are affected by the plurality of objects and are independently outputted, and

at the action control step, the action of the robot device is controlled on the basis of the instinct and the emotion outputted at the instinct output step and the emotion

output step.

65. A robot device comprising:

an emotion module in which a plurality of emotion units representing emotions output individual emotions;

an instinct module in which a plurality of instinct units representing instincts output individual instincts; and

action means for acting on the basis of the emotion outputted by the emotion module and the instinct outputted by the instinct module.

66. The robot device as claimed in claim 65, wherein the emotion units are affected by an instinct outputted by the instinct module, and

the instinct units are affected by an emotion outputted by the emotion module.

67. The robot device as claimed in claim 65, wherein the plurality of emotion units affect one another to output an emotion.

68. The robot device as claimed in claim 65, further comprising a plurality of objects designed by an object-oriented design corresponding to the behavior of a living body,

wherein the emotion module outputs an emotion on the basis of information from the plurality of objects,

the instinct module outputs an instinct on the basis of information from the plurality of objects,

the plurality of objects affect one another and affect the emotion from the

emotion module and the instinct from the instinct module so as to output the information.

69. The robot device as claimed in claim 65, wherein the emotion units and the instinct units are designated by an object-oriented design.

70. The robot device as claimed in claim 66, wherein the action means includes a plurality of objects each being designated by an object-oriented design corresponding to means for the behavior of a living body.

71. The robot device as claimed in claim 65, wherein the emotion module outputs information of an emotion unit having a high emotion level as the emotion, and

the instinct module outputs information of an instinct unit having a high instinct level as the instinct.

72. A control method for a robot device comprising:

an emotion output step of outputting individual emotions by a plurality of emotion units representing emotions;

an instinct output step of outputting individual instincts by a plurality of instinct units representing instincts; and

an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step and the instinct outputted at the instinct output step.

73. The control method for a robot device as claimed in claim 72, wherein the emotion units are affected by an instinct outputted at the instinct output step, and

the instinct units are affected by an emotion outputted at the emotion output step.

74. The control method for a robot device as claimed in claim 72, wherein the plurality of emotion units affect one another to output an emotion.

75. The control method for a robot device as claimed in claim 72, wherein at the emotion output step, an emotion is outputted on the basis of information from a plurality of objects each being designated by an object-oriented design corresponding to the behavior of a living body, and

at the instinct output step, an instinct is outputted on the basis of information from a plurality of objects each being designated by an object-oriented design corresponding to the behavior of a living body,

the plurality of objects affecting one another and affecting the emotion from the emotion module and the instinct from the instinct module so as to output the information.

76. The control method for a robot device as claimed in claim 72, wherein the emotion units and the instinct units are designated by an object-oriented design.

77. The control method for a robot device as claimed in claim 72, wherein at the emotion output step, information of an emotion unit having a high emotion level is outputted as the emotion, and

at the instinct output step, information of an instinct unit having a high instinct level is outputted as the instinct.

78. A program recording medium having recorded therein a program for carrying out:

an emotion output step of outputting individual emotions by a plurality of emotion units representing emotions;

an instinct output step of outputting individual instincts by a plurality of instinct units representing instincts; and

an action control step of controlling the action of the robot device on the basis of the emotion outputted at the emotion output step and the instinct outputted at the instinct output step.

79. The program recording medium as claimed in claim 78, wherein the emotion units are affected by an instinct outputted at the instinct output step, and

the instinct units are affected by an emotion outputted at the emotion output step.

80. The program recording medium as claimed in claim 78, wherein the plurality of emotion units affect one another to output an emotion.

81. The program recording medium as claimed in claim 79, wherein at the emotion output step, an emotion is outputted on the basis of information from a plurality of objects each being designated by an object-oriented design corresponding to the behavior of a living body, and

at the instinct output step, an instinct is outputted on the basis of information from a plurality of objects each being designated by an object-oriented design

corresponding to the behavior of a living body,

the plurality of objects affecting one another and affecting the emotion from the emotion module and the instinct from the instinct module so as to output the information.

82. The program recording medium as claimed in claim 78, wherein the emotion units and the instinct units are designated by an object-oriented design.

83. The program recording medium as claimed in claim 78, wherein at the emotion output step, information of an emotion unit having a high emotion level is outputted as the emotion, and

at the instinct output step, information of an instinct unit having a high instinct level is outputted as the instinct.

84. A robot device comprising:

detection means for detecting a stimulus applied from outside;

storage means for storing the record of information related to the stimulus;

response processing decision means for deciding response processing on the basis of the stimulus detected by the detection means; and

response execution means for executing the response processing decided by the response processing decision means;

the response processing decision means deciding the response processing on the basis of the record information stored in the storage means.

85. The robot device as claimed in claim 84, wherein the response processing

decision means is an emotion module for deciding an emotion in response to an emotion level, which is the record information, changing in response to the stimulus due to an emotion, and

the response execution means takes a behavior and/or an action for expressing the emotion decided by the emotion module.

86. The robot device as claimed in claim 84, wherein the response processing decision means is an instinct module for deciding an instinct in response to an instinct level, which is the record information, changing in response to the stimulus due to an instinct, and

the response execution means takes a behavior and/or an action for expressing the instinct decided by the instinct module.

87. A control method for robot device comprising:

a detection step of detecting a stimulus applied to the robot device from outside;

a response processing decision step of deciding response processing of the robot device on the basis of the stimulus detected at the detection step; and

a response execution step of causing the robot device to execute the response processing decided at the response processing decision step;

wherein at the response processing decision step, the response processing is decided on the basis of the record information stored in storage means.

88. The control method for a robot device as claimed in claim 87, wherein the response processing decision means is an emotion module for deciding an emotion in

response to an emotion level, which is the record information, changing in response to the stimulus due to an emotion, and

the response execution means causes the robot device to take a behavior and/or an action for expressing the emotion decided by the emotion module.

89. The control method for a robot device as claimed in claim 87, wherein the response processing decision means is an instinct module for deciding an instinct in response to an instinct level, which is the record information, changing in response to the stimulus due to an instinct, and

the response execution means causes the robot device to take a behavior and/or an action for expressing the instinct decided by the instinct module.

90. A program recording medium having recorded therein a program for carrying out:

a detection step of detecting a stimulus applied to a robot device from outside;

a response processing decision step of deciding response processing of the robot device on the basis of the stimulus detected at the detection step; and

a response execution step of causing the robot device to execute the response processing decided at the response processing decision step;

wherein at the response processing decision step, the response processing is decided on the basis of the record information stored in storage means.

91. The program recording medium as claimed in claim 90, wherein the response processing decision means is an emotion module for deciding an emotion in response

to an emotion level, which is the record information, changing in response to the stimulus due to an emotion, and

the response execution means causes the robot device to take a behavior and/or an action for expressing the emotion decided by the emotion module.

92. The program recording medium as claimed in claim 90, wherein the response processing decision means is an instinct module for deciding an instinct in response to an instinct level, which is the record information, changing in response to the stimulus due to an instinct, and

the response execution means causes the robot device to take a behavior and/or an action for expressing the instinct decided by the instinct module.

ABSTRACT

When the information is inputted from the recognition object, the emotion module discriminates the type of the inputted information (step ST1) and changes the emotion level of each emotion unit using the parameter corresponding to the inputted information (step ST2), as shown in Fig.4. The emotion module selects the emotion unit having the maximum emotion level from among the emotion units having the emotion levels exceeding the threshold value. The selected emotion unit notifies the object which is requesting the output, for example, the behavior production object, of that information.

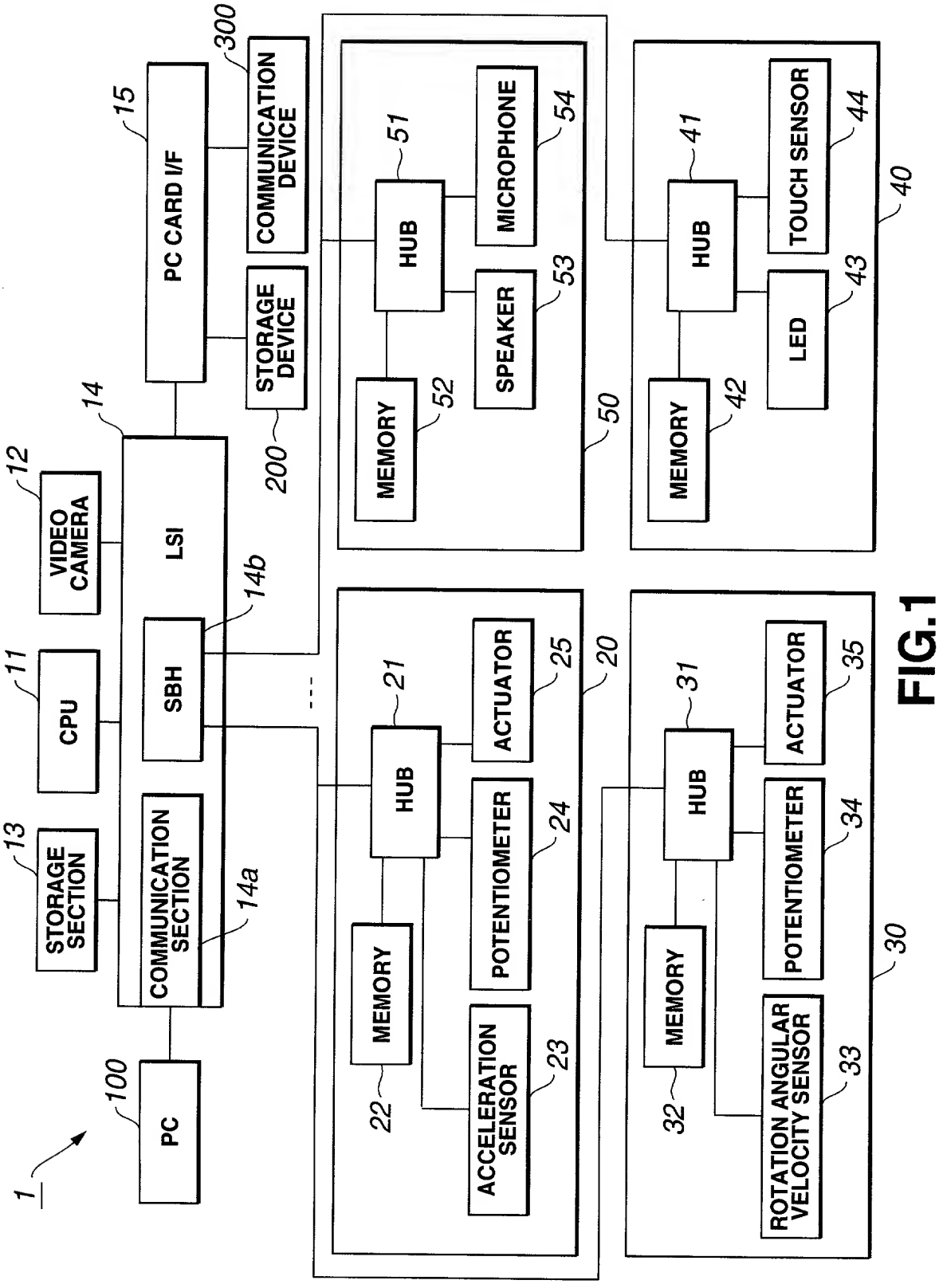
1
PC
100
COMMUNICATION SECTION
14a
STORAGE SECTION
13
CPU
11
VIDEO CAMERA
12
SBH
LSI
14
14b
PC CARD I/F
15
STORAGE DEVICE
200
COMMUNICATION DEVICE
300
HUB
21
MEMORY
22
ACCELERATION SENSOR
23
POTENTIOMETER
24
ACTUATOR
25
20
HUB
31
MEMORY
32
ROTATION ANGULAR VELOCITY SENSOR
33
POTENTIOMETER
34
ACTUATOR
35
30
HUB
51
MEMORY
52
SPEAKER
53
MICROPHONE
54
50
HUB
41
MEMORY
42
LED
43
TOUCH SENSOR
44
40
...

FIG.1

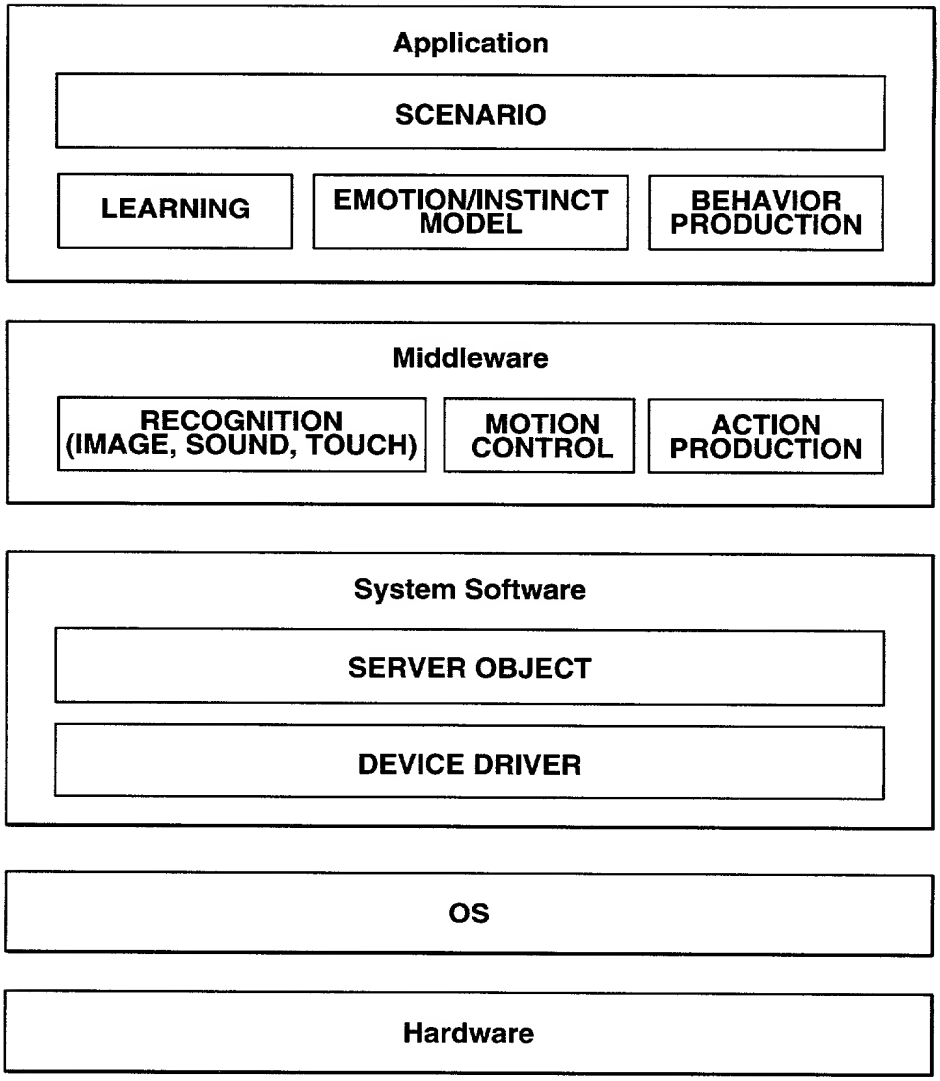

FIG.2

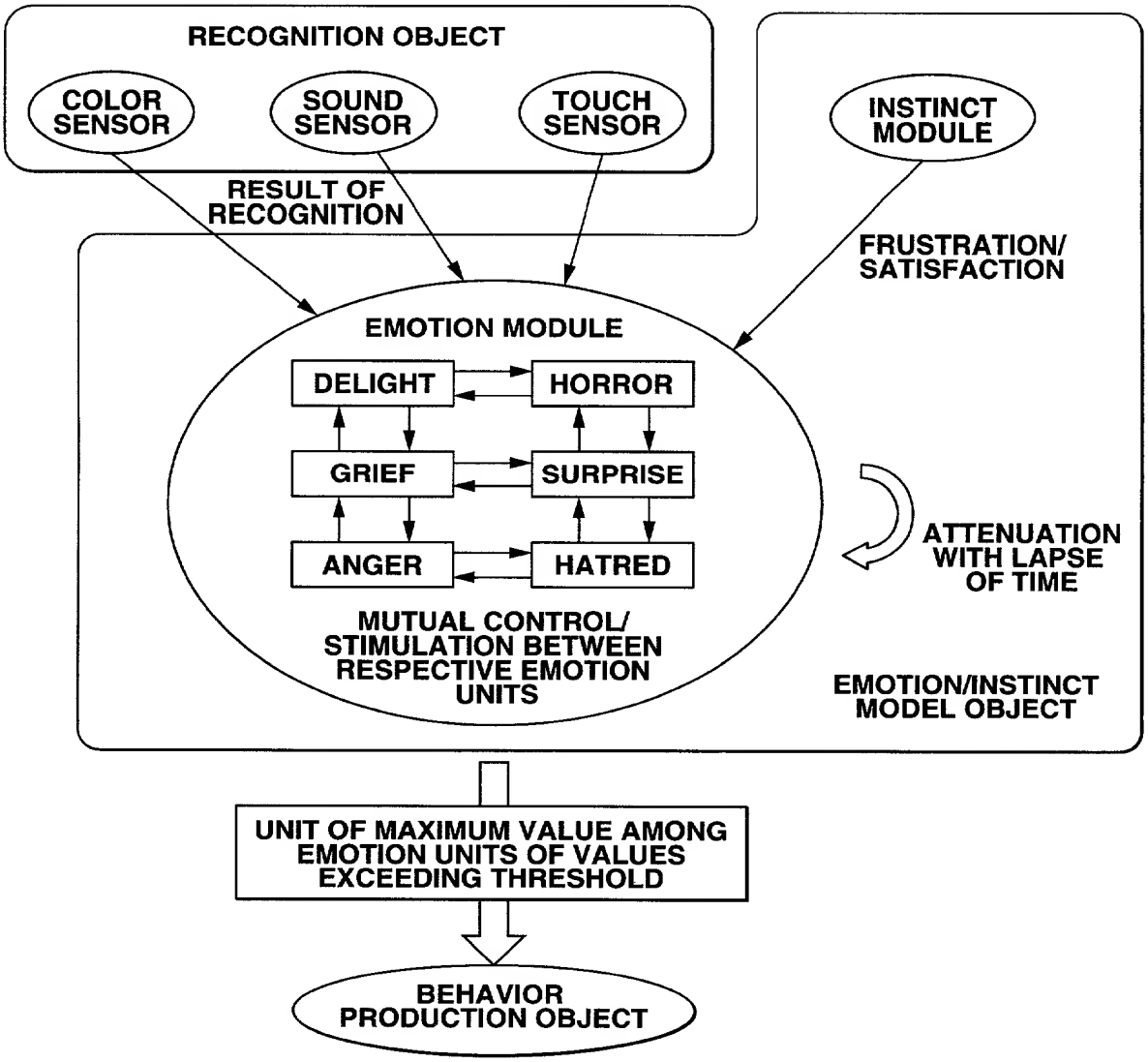
RECOGNITION OBJECT
COLOR SENSOR
SOUND SENSOR
TOUCH SENSOR
INSTINCT MODULE
RESULT OF RECOGNITION
FRUSTRATION/ SATISFACTION
EMOTION MODULE
DELIGHT
HORROR
GRIEF
SURPRISE
ANGER
HATRED
ATTENUATION WITH LAPSE OF TIME
MUTUAL CONTROL/ STIMULATION BETWEEN RESPECTIVE EMOTION UNITS
EMOTION/INSTINCT MODEL OBJECT
UNIT OF MAXIMUM VALUE AMONG EMOTION UNITS OF VALUES EXCEEDING THRESHOLD
BEHAVIOR PRODUCTION OBJECT

FIG.3

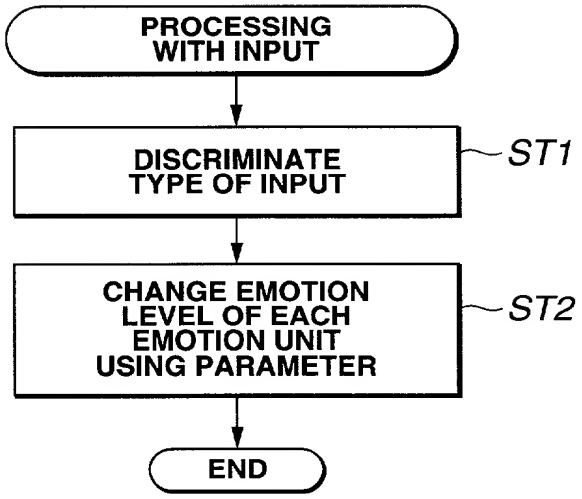

FIG.4

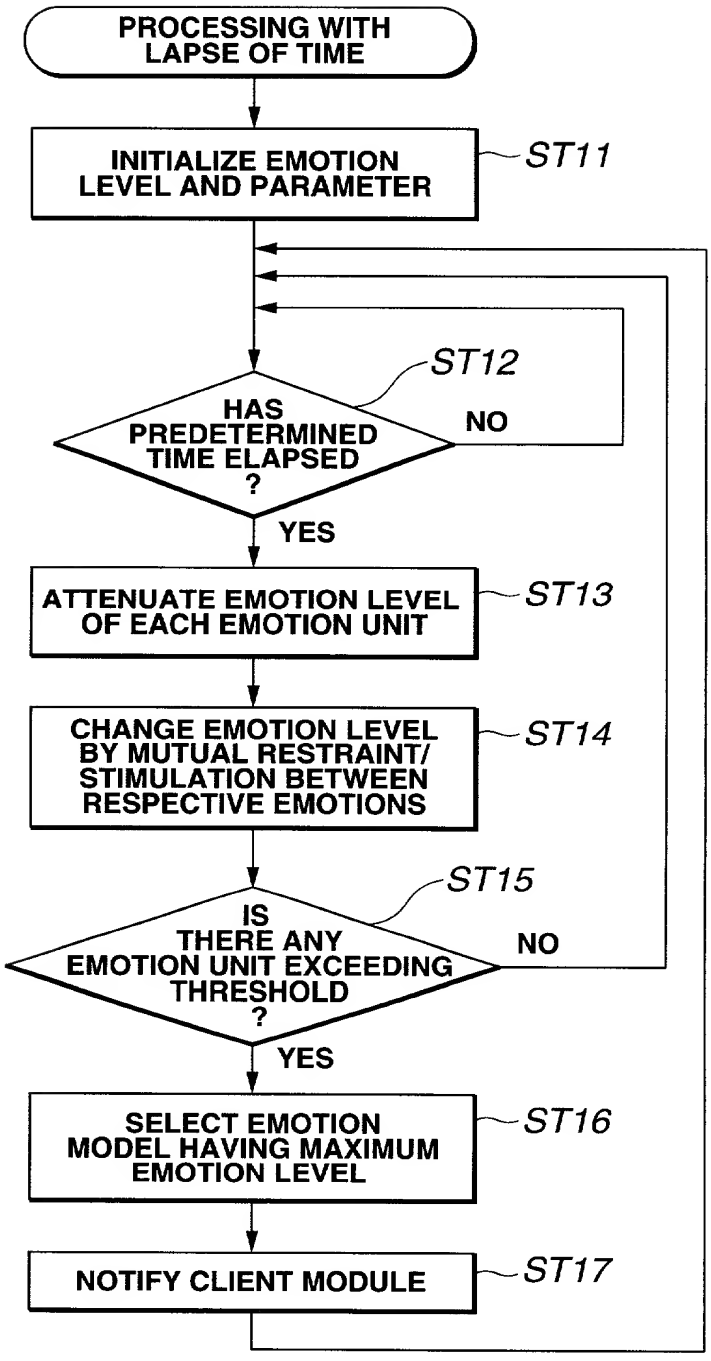
PROCESSING WITH LAPSE OF TIME
INITIALIZE EMOTION LEVEL AND PARAMETER
ST11
HAS PREDETERMINED TIME ELAPSED ?
ST12
NO
YES
ATTENUATE EMOTION LEVEL OF EACH EMOTION UNIT
ST13
CHANGE EMOTION LEVEL BY MUTUAL RESTRAINT/ STIMULATION BETWEEN RESPECTIVE EMOTIONS
ST14
IS THERE ANY EMOTION UNIT EXCEEDING THRESHOLD ?
ST15
NO
YES
SELECT EMOTION MODEL HAVING MAXIMUM EMOTION LEVEL
ST16
NOTIFY CLIENT MODULE
ST17

FIG.5

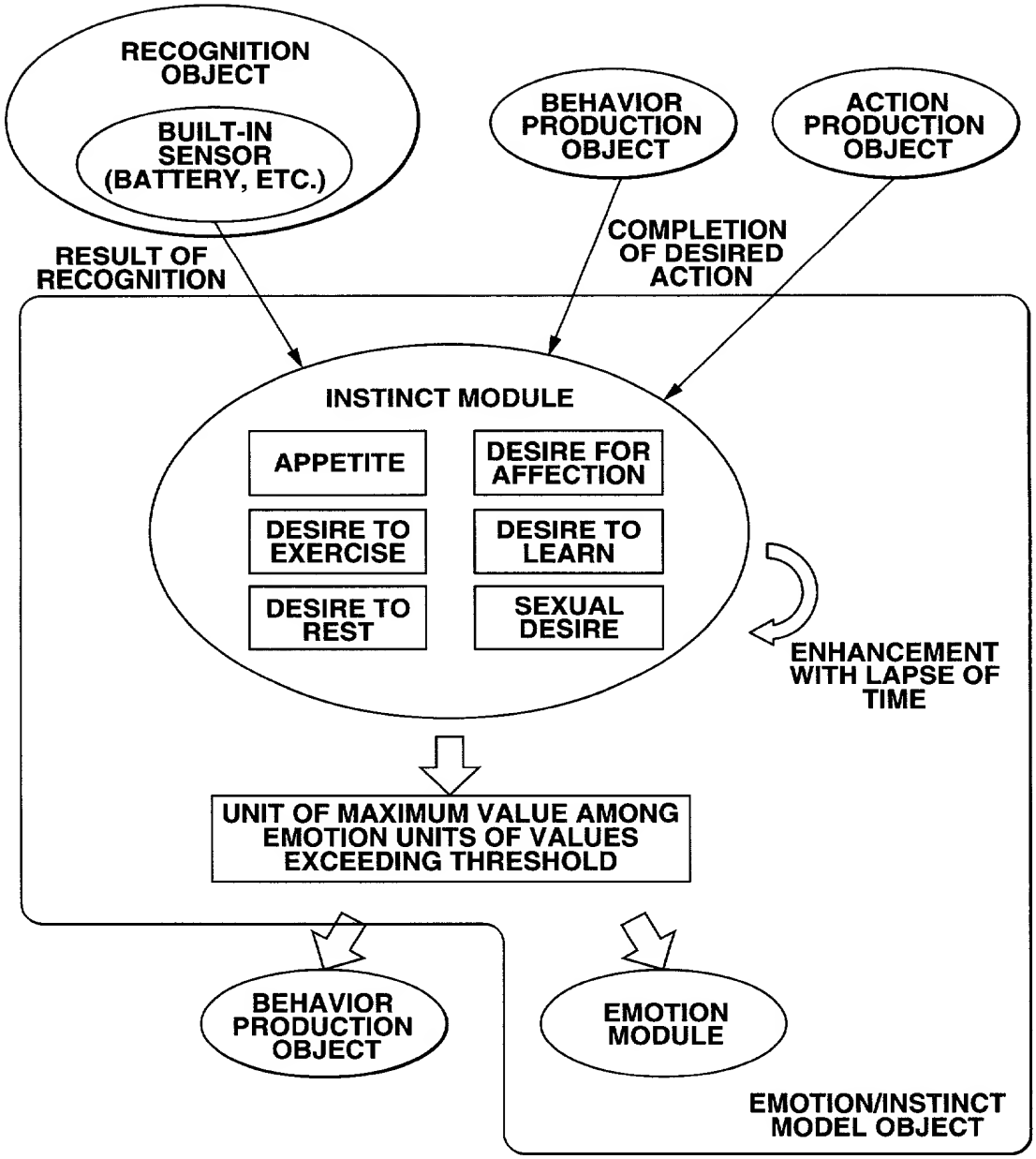
RECOGNITION OBJECT
BUILT-IN SENSOR (BATTERY, ETC.)
BEHAVIOR PRODUCTION OBJECT
ACTION PRODUCTION OBJECT
RESULT OF RECOGNITION
COMPLETION OF DESIRED ACTION
INSTINCT MODULE
APPETITE
DESIRE FOR AFFECTION
DESIRE TO EXERCISE
DESIRE TO LEARN
DESIRE TO REST
SEXUAL DESIRE
ENHANCEMENT WITH LAPSE OF TIME
UNIT OF MAXIMUM VALUE AMONG EMOTION UNITS OF VALUES EXCEEDING THRESHOLD
BEHAVIOR PRODUCTION OBJECT
EMOTION MODULE
EMOTION/INSTINCT MODEL OBJECT

FIG.6

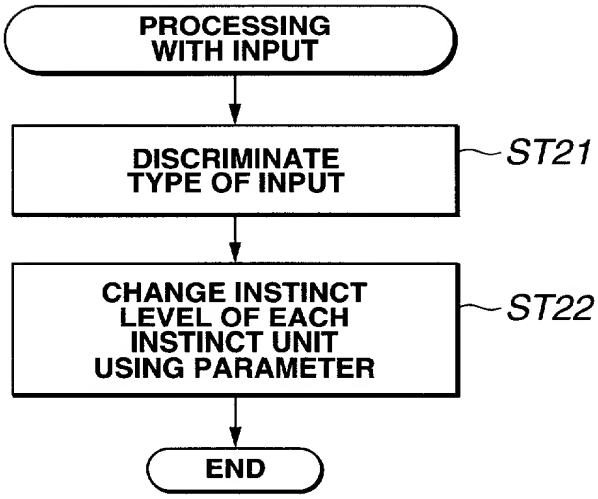

FIG.7

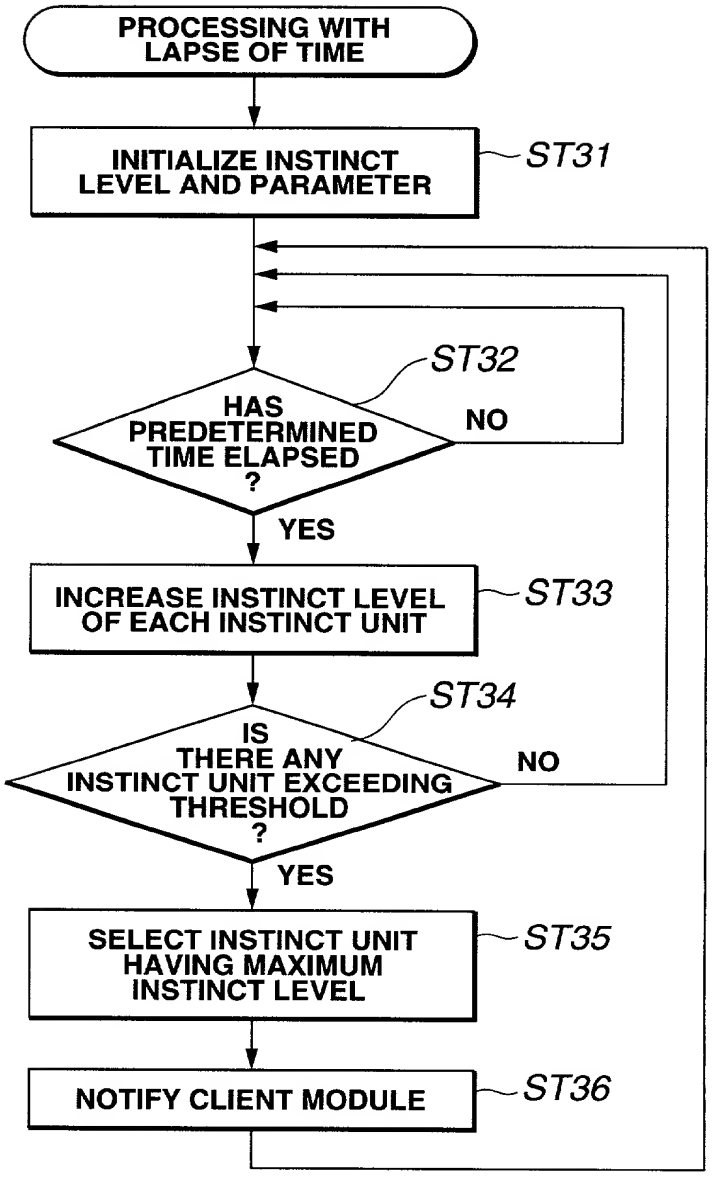
PROCESSING WITH LAPSE OF TIME
INITIALIZE INSTINCT LEVEL AND PARAMETER
ST31
ST32
HAS PREDETERMINED TIME ELAPSED ?
NO
YES
INCREASE INSTINCT LEVEL OF EACH INSTINCT UNIT
ST33
ST34
IS THERE ANY INSTINCT UNIT EXCEEDING THRESHOLD ?
NO
YES
SELECT INSTINCT UNIT HAVING MAXIMUM INSTINCT LEVEL
ST35
NOTIFY CLIENT MODULE
ST36

FIG.8

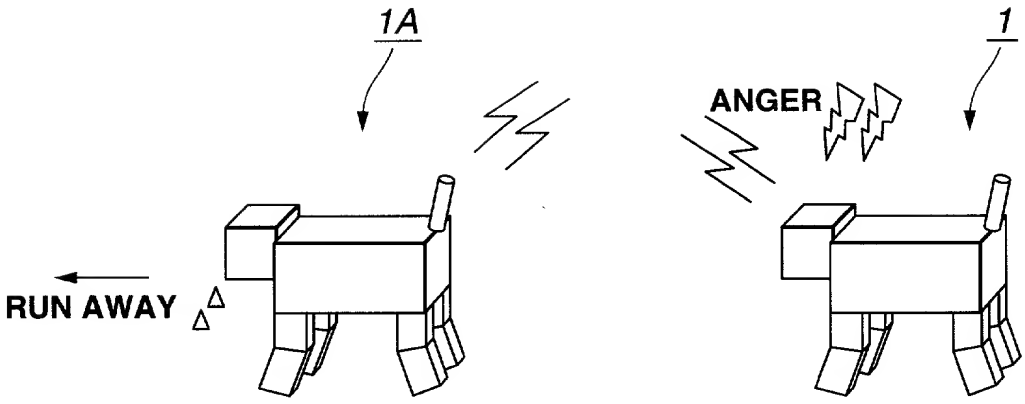

FIG.9

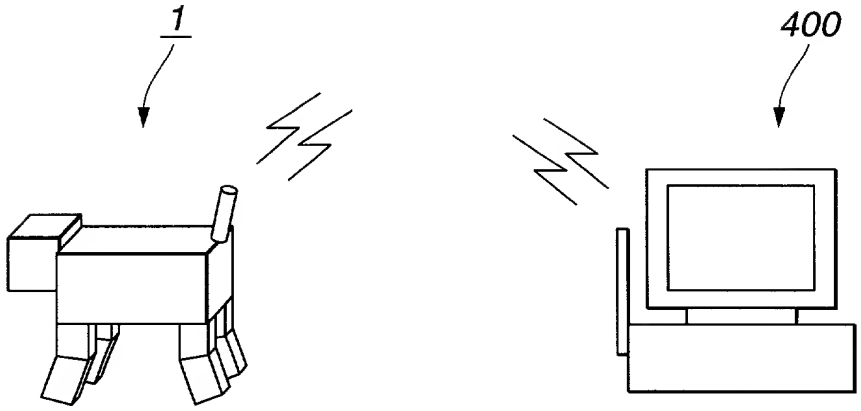

FIG.10

S99P1351US00

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Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Declaration and Power of Attorney For Patent Application

特許出願宣言書及び委任状

Japanese Language Declaration

日本語宣言書

下記の氏名の発明者として、私は以下の通り宣言します。	As a below named inventor, I hereby declare that:
私の住所、私書箱、国籍は下記の私の氏名の後に記載された通りです。	My residence, post office address and citizenship are as stated next to my name.
下記の名称の発明に関して請求範囲に記載され、特許出願している発明内容について、私が最初かつ唯一の発明者（下記の氏名が一つの場合）もしくは最初かつ共同発明者であると（下記の名称が複数の場合）信じています。	I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
_____	ROBOT DEVICE, CONTROL METHOD FOR ROBOT DEVICE, AND PROGRAM RECORDING MEDIUM
_____	_____
上記発明の明細書（下記の欄でx印がついていない場合は、本書に添付）は、	the specification of which is attached hereto unless the following box is checked:
☐ __月__日に提出され、米国出願番号または特許協定条約国際出願番号を_____とし、（該当する場合）_____ に訂正されました。	☒ was filed on November 30, 1999 as United States Application Number or PCT International Application Number PCT/JP99/06713 and was amended on _____ (if applicable).
私は、特許請求範囲を含む上記訂正後の明細書を検討し、内容を理解していることをここに表明します。	I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.
私は、連邦規則法典第３７編第１条５６項に定義されるとおり、特許資格の有無について重要な情報を開示する義務があることを認めます。	I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

S99P1351 U.S.00

PTO/SB/106(8-96)
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(日本語宣言書)

私は、米国法典第３５編１１９条(a)-(d)項又は３６５条(b)項に基き下記の、米国以外の国の少なくとも一カ国を指定している特許協力条約３６５(a)項に基づく国際出願、又は外国での特許出願もしくは発明者証の出願について外国優先権をここに主張するとともに、優先権を主張している、本出願の前に出願された特許または発明者証の外国出願を以下に、枠内をマークすることで、示しています。

I hereby claim foreign priority under Title 35, United States Code, Section 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)
外国での先行出願

(Number) (番号)	(Country) (国名)	(Day/Month/Year Filed) (出願年月日)	Priority Claimed 優先権主張 Yes はい	No いいえ
P10- 340716	Japan	30/11/1998	☒	☐
			☐	☐

私は、第３５編米国法典第１１９条(e)項に基いて下記の米国特許出願規定に記載された権利をここに主張いたします。

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Application No.) (出願番号)	(Filing Date) (出願日)

私は、下記の米国法典第３５編１２０条に基いて下記の米国特許出願に記載された権利、又は米国を指定している特許協力条約３６５条(c)に基づく権利をここに主張します。また、本出願の各請求範囲の内容が米国法典第３５編１１２条第１項又は特許協力条約で規定された方法で先行する米国特許出願に開示されていない限り、その先行米国出願書提出日以降で本出願書の日本国内または特許協力条約国際提出日までの期間中に入手された、連邦規則法典第３７編１条５６項で定義された特許資格の有無に関する重要な情報について開示義務があることを認識しています。

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s), or 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of application.

(Application No.) (出願番号)	(Filing Date) (出願日)	(Status: Patented, Pending, Abandoned) (現況：特許許可済、係属中、放棄済)

私は、私自身の知識に基づいて本宣言書中で私が行なう表明が真実であり、かつ私の入手した情報と私の信じるところに基づく表明が全て真実であると信じていること、さらに故意になされた虚偽の表明及びそれと同等の行為は米国法典第１８編第１００１条に基づき、罰金または拘禁、もしくはその両方により処罰されること、そしてそのような故意による虚偽の声明を行なえば、出願した、又は既に許可された特許の有効性が失われることを認識し、よってここに上記のごとく宣言を致します。

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Japanese Language Declaration
(日本語宣言書)

委任状： 私は下記の発明者として、本出願に関する一切の手続きを米特許商標局に対して遂行する弁理士または代理人として、下記の者を指名いたします。（弁護士、または代理人の氏名及び登録番号を明記のこと）

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith (*list name and registration number*).

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(Supply similar information and signature for third and subsequesnt joint inventors.)